Notebook Series -- Notebooks by Experimenters Other Than Edison
Phonograph Record Experiments -- Disc Plating Books
Notebook, N-13-09-27

This notebook was used by William W. Dinwiddie during September 1913-August 1914. One additional notation was probably made in February 1915. The book begins with the inscription, "Let no one see this book without very definite orders from Mr. Edison." The entries consist primarily of a series of formulas, along with instructions describing current practices for plating the masters and submasters used in making Edison disc records. These were probably the culmination of numerous plating experiments documented in earlier books in this subgroup. Additional experimentation produced modifications in formulas and practices. For example, the use of submasters was discontinued shortly after 1913. Some of the formulas have been crossed out and changed, with an indication of the date on which the practice changed.

Among the practices described in this notebook is the method of preparing "dopes" (caminol and copper ink) for use in plating the wax masters, along with an indication of the object of using each dope. Also included is a description of the method of purifying the graphite used to make a conducting surface on the wax. In addition, there is a description of the formula and method of molding the wax masters, as well as an analysis of the defects in disc molds. There are indications that H. Grimes worked with Dinwiddie on some of these experiments. Several notes and letters to and from Dinwiddie dating from 1917-1920 are inserted into the book. The front cover is labeled "Copper Plating Phonograph Records." The book contains 28 numbered pages; some pages are blank.

W.W. Dinwiddie 9/27/13

Let No One see This book without very desinite orders from Mr. Edison.
W.W.D.

56700
Arnne Co.,
MFG. STATIONERS,
96 JOHN ST.
AND
19 PLATT ST.
NEW YORK.

Dope for regular baths for heavy plating.

Caminol.

500 g. Caramel dissolved hot in regular plating solution ½ strength. made up to 2500 cc when cold. by adding water.
Each 5cc Caminol contains 1g. Caramel.

Caramel.

(Cane sugar heated slowly until 210° C and kept at this temperature until it looses 10% of its weight.)

For covering baths 1875 cc to 160 litres solution
See page 12

For Wurth cylinder baths 500cc to 22 gallons.

For Regular Baths 5000 cc to 300 gallons.
add more when work shows crystals.

For 80 Baths in Continual use 1250 CC
Caminol added per week keeps them in Condition

See schedule for covering Page 7–9
with Copper Ink solution

Dope for Covering Baths.
Copper Ink.

20 g. ✱62 dissolved in 2500 cc regular solution.

2500 cc Copper Ink to 40 gallons solution.

see page 12

✱62 = Azurino = Erioglaweine.
Made by Heller & Merz, 505 Hudson Street N.Y.
10 lbs bought 9/23/13 was from their batch №73.

Solution requires to be used for a week or ten days to acquire the desired properties.
At first, except at very low current density, the surface is covered with brown mottles in a beautiful spiral form. Copper is too hard and is brittle, but has, even then, its "covering power" six times - that of ordinary copper. ~~Two holes~~
When solution is in perfect condition 15 amps will not show more than a trace here and there of this brown mottling on the extreme edge or corner of the Record. Submaster Record. Margin
little dashes of brown like this ~~Music~~

The need of more dope is indicated by the records taking a longer time to cover. more dope may be added 100 cc per hour until trace of mottles appears on edge.

See Page 5 for Chemical curing

See Page 4 for later practice.

Chemical Curing Copper Ink Doped Solution.

To each bath of new solution (4 gallons) (15½ litres exact) add 300 cc Copper ink (page 3) then add 80 cc ("Curing Dope") Hydrogen Peroxide (Baker & Adamson 3%) Before connecting circulation with other baths test by plating a discarded Submaster, and striping after plating 1¼ hours, after covering by regular schedule. Plating should be hard and curl up, should be free from pin holes. Too much "Curing Dope" will make copper soft. Too little makes warts and Buckles on Master Moulds

Solution For Master Room should be taken from submaster room, and all new solution added in submaster room. When copper becomes too soft add more copper ink – not faster than 100 cc per hour, and not more than 200 cc per ~~day for 40 gallons solution.~~ Look out For warts on Masters.

See schedule for covering – pages 7–9

W. W. Dividdia July 4-14

After fire in February 1915 – had considerable difficulty in curing with H_2O_2 – Neutralized the Copper Sulfate completely before curing. Cured solution without it in 72 hours at light density.

Low. Density Start Schedule for covering submasters in "Copper Ink" doped solution. Wash w. machine.

Start 1 amp. → have jets on, circulation on, bath 76° ± 2° F, surface of bath well skimmed with air and overflow.
Cov. 3/8 from edge 2 amp.
Cov. 1" from edge 3 amp.
Cov. 2" " " 4 amp.
Music Covered 5 amp.
To Label 6 amp.
2" diameter remaining 7 amp.
1" diameter remaining 8 amp.
All covered ——— 10 amp. → Put on celluloid cover.
After one minute 12 amp. → The main object for this final boost is to insure that attendant notices bath soon after cover is put on it is then likely to run undisturbed for 2 hours without trouble.
Plate 2 hours and Transfer to general baths.
Wash thoroly and transfer as quickly as possible. Keep very wet

W. W. Dimmiddis July 4-14

When submasters are transferred to general baths they show a peculiar pink or old rose color — This is due to burning at the tips of millions of very minute hair like warts.

W. W. D. Aug 11-14

Schedule for Covering White Masters in Copper Ink Doped Solution.

1. Put Rubber plug in center.
2. Blow off with compress air.
3. See that bath is perfectly skimmed, air and circulation on. Temperature 76° F ± 1° F. Keep Temp. between 75°-77°.
4. Put in bath — keep turning over away from you while going down in solution and until belt is on.

5. Adjust jets — { Be sure that A does not strike in thick layer of solution thrown by B etc — will make bubbles.
6. Start 1 amp.

3/8" covered 1½ amp. boost before music is reached
⅞-1" covered 2 amp.
1¼-1½ " 2½ "
1¾-2" " 3 "
2¼-2½ " 3½ "
2¾-3 " 4 "
3¼-3½ 4½ "
3¾-4" or music covered, unless very narrow, 5 amp.
2½" diameter remaining 6 amp
2" " " 7 "
All covered 8 Amperes.
Then boost every 4 or 5 minutes 1 amp until 15 amp and plate 5 hours before transferring to regular baths. W. W. Dimwiddie July 4-14

Object of using Gamimol.
Prevents large crystals.
Makes fine grain smooth molds - easy to turn up.

Object of using Copper Ink
1 Prevents pin holes ABSOLUTELY .0015 inch thick
2 Makes Very Hard copper - without loss of Tensile strength - 84,000 lbs per Sq. inch (max.)
3 Graphited records cover in 1/15 of the time required under same conditions in plain solution.

Hardrubber plating bath for 10" records
holds 15.5 litres filled to within 35 m.m. of top,
with anode, filter, spider and record in place.

Master Room—
18 baths 279 litres + pipes etc = 300 litres

Submaster Room
24 baths 372 litres + pipes etc = 400 litres

Stone crocks 56 cm diameter 62 cm deep.
contains 2500 cc per cm of height—
or 5 litres per 2 cc of depth of solution.

One litre Solution Contains—
Blue Copper
200 g. $CuSO_4$ — Copper Sulfate
25 cc H_2SO_4 — Sulfuric Acid
Specific Gravity 1.815

W.W.D. Aug 11-14

To test solution for Copper and Acid see pages 13-14

Solution to Test for Copper—

96 g KCN.
2234 cc Water.

Measure 4.5 cc Plating Solution
Add 10.0 cc water
Add 8.0 cc Ammonia (28%) 9.4% made from 1 part Water 2 parts,
20 cc of above KCN solution will clear if Copper is right—
Each cc more than 20 required means 50 cc water must be added to each litre of solution.
Each cc under 20 required to clear means each litre of solution requires 10 g $CuSO_4$.

When New KCN solution is made up test it on standard plating solution page 12—
W.W.D. Aug 11-14

Solution To Test for Acid.

KOH 1-80.

| 3 parts 33% KOH
| 77 parts Water

| 10 cc – plating solution to be tested
| 15 cc – Water

If plating solution contains right amount of acid 25 cc KOH solution will make it permanently milky.

| For each cc under 25 required
| add 1 cc H_2SO_4 per litre of solution
| For each cc over 25 required
| add 40 cc water per litre of solution

When New KOH Solution is made up test it on standard plating solution-page 12.

W.W.D. Aug 11-14

used previous to Jan. 1914.

Wax. (Page 16)

1 { (4643) (4580) g. Caustic Soda
(1800) (1750) g. pure Aluminum Metal
(224) (225 lbs. Recrystalized Sal Soda
about 30 gallons water.
boil together until all aluminum is dissolved then filter.

2 { Melt 1000 lbs Stearic Acid – heat to 330° – Add slowly solution (1) then raise temperature to 420° and "foam off" all water. (P 25)

(Standard Oil Company FFF Valoc Oil) (Mix well)

3 { Add (75) (lead) pounds ~~white rosebud~~ and raise temperature to 450° and hold for about one hour. (P 25)

(P 21) Congealing point should be 270° F. If too high one percent of Stearic Acid for each 5° too high will make it right.

Filter, and centrifuge to remove very small amt of heavy matter. pour in pans to cool –

1045 lbs.

Analysis of Defects in Disc Moulds.

(P15) **Wax**

Smoothness of cut varies with softener used
Hardness varies with softener + Congealing point. (P21)
Grain - Fine - nearly amorphous with proper chilling
Egg Shell surface - blank not chilled. Traces with chilled blank used green and not plated immediately. also (F P24)
Attacked by solution - Congealing (P21) point (P25) too high bad Stearic Acid crystaline Vaseline
Streaks or patches of egg shell surface - solid chip of wax falling in mould.
Center or outside of blank with louder surface -
(J P24) Disc warped after removing from mould from cooling too fast on one side.
Chips - Loose chips are all removed by cleaning machine. Chips welded on due to sticky wax, or to pressure or being blown against the surface.
Blinds - Dirt or Fibre in wax.
Holes - Air or dirt in wax.
Mechanical defects of recording.
Mechanical injuries - Finger marks.
Attacked by air - Oleic acid in excess (P25)

Analysis of defects in Disc Moulds (Continued)

Cleaning- Graphiting- etc -	Mechanical injuries. Moisture spots. Dirt. Poor conducting Graphite.

Preliminary Plating	Oily dust floating on bath - bath not well skimmed and speck of dust adheres to the record — on account of its being oily it will not wet so it holds a minute bubble of air. Holes look like bubbles. Particles of loose graphite not blown off or washed off by jets. Moisture spots, oil spots, fingermarks. Buckles - due to too strong dope in bath. Soft copper - due to too little dope in bath, indicated by slow plating. Mechanical injuries.

Analysis of defects in Disc Moulds (Continued)

Outside baths-	Keep temperature constant or solution will get under and attack surface of mould.
Polishing -	Not cleaning thoroly Mechanical Injuries
Turning etc.	Mechanical Injuries. Buckles
Mounting in Steel Holders	Buckles due to dirt behind Mechanical Injuries
Celluloid prints-	Celluloid defects. defects in dipping. Scratches filled with Graphite. Repeats – squeaks. Not full print- defect in temperature or pressure, Schedule not followed. Mechanical Injuries - to mould or print. Dirt on mould or Celluloid Finger marks (P28) Oil. spoils Label

Analysis of defects in Disc Moulds (Continued)

Repairing:
- Incomplete or imperfect repairs.
- Mechanical injuries - repair tool etc.
- Cut by reproducer.
- Finger marks. (P 28)

Graphiting Celluloid Prints.
- Too much graphite.
- moisture or oil spots.
- finger marks. (P 28)
- mechanical injuries

Plating: submistakes
- loose graphite not blown off.
- Washing, not thorough. or algae not filtered from water
- Dirt in solution - looks like algae. (from finger fuzz. clean all pipes & filter.)
- Dust on surface of solution - Not properly skimmed when record is put in.

Working moulds.
- Turning Mounting etc - Mechanical injuries —
- Buckles - Dirt in Holder under mould.

Analysis of defects in Disc Moulds (Continued)

Commercial Printing — Mechanical injuries.—
Dust-sand or dirt-particles of varnish between mould and blank.
Fine scratches.

Congeling Point of Wax.

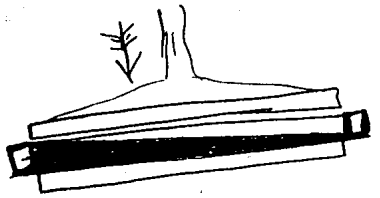
Take about 200 cc Melted wax in small dipper.
Stir continually with thermometer.
Hold in good light – not in a draught.
Read thermometer when a very delicate scum forms at the surface – looks like very delicate spider lines, or very delicate firm wrinkling on the surface.
Should be 270° F (Page 15) (Page 16)
Read Thermometer closely when near right. See that there is no break in mercury of thermometer if reading is high.

360° F is standard temperature for pouring the wax in moulds.

Wax Casting Machine.

Mould – See Blue Print insert at back of this book.

Back of machine is raised about 1" higher than front to let air out.



— wax surface level.

Operations

1 Steam in top and bottom plate and ring – wax is poured. Must be hot (24 I) (also see Page 21)

2 Top plate moved down against wax.

3 Water at 95° run thru jackets in place of steam.

5 minutes ↑

(Follow up contraction of wax with press)

↓

4 Steam off ring.

5 minutes ↑

(Follow up contraction of wax with press)

↓

5 Lift top plate a little when bottom plate will let go.

6 Return press again to contact.

7 Run steam in ring until it is free.

8. Lift top plate. If it does not let go, finger nail will start it.

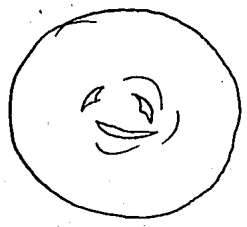
Wax Casting Machine.

9 Remove Ring

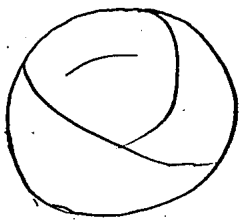
10 Lift off wax disc.

11 Cool between flat plates. ~~Board~~ sheets

Causes of Defects. . . . wax casting

A 

cracks and pull outs. too much pressure between operations 4 and 5

B 

Cracks. Water too cold or left in mould too long. Never have water above 95° F as wax will be too soft. also see (K)

C If time between operations 3 & 4 is too long top of mould may let go first from wax.

D If time between operations 3 & 4 is too short - blank may be concave on both sides or porus in center.

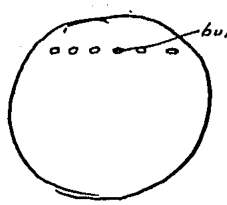
E If time between operations 3 & 5 is too short blank will be too soft and surface may be cracked in handling

K - Valve in circulation pipe from the lower steam plate is to reduce the flow thru this pipe and equalize the effect of the small flexible tubes to the top movable plate so that the two plates cool and heat up at the same rate, Handle should be removed when this valve is once adjusted.

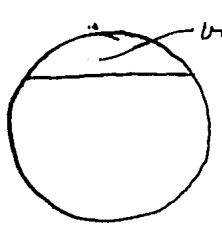
L - Never obstruct the exhaust side of the steam jackets because they are not designed to stand pressure.

Wax Casting (Continued)

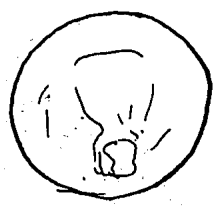
F. Water-circulation obstructed or water too warm. makes same defect as E Also Wax not properly chilled and consequent Egg Shell surface (Page 16)

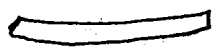
G 

Press moved down irregularly after contact with wax.

H 

wax on back edge of top plate - not cleaned properly. Prevents air from being forced out.

I 
lines on bottom of disc. mould not hot at start.

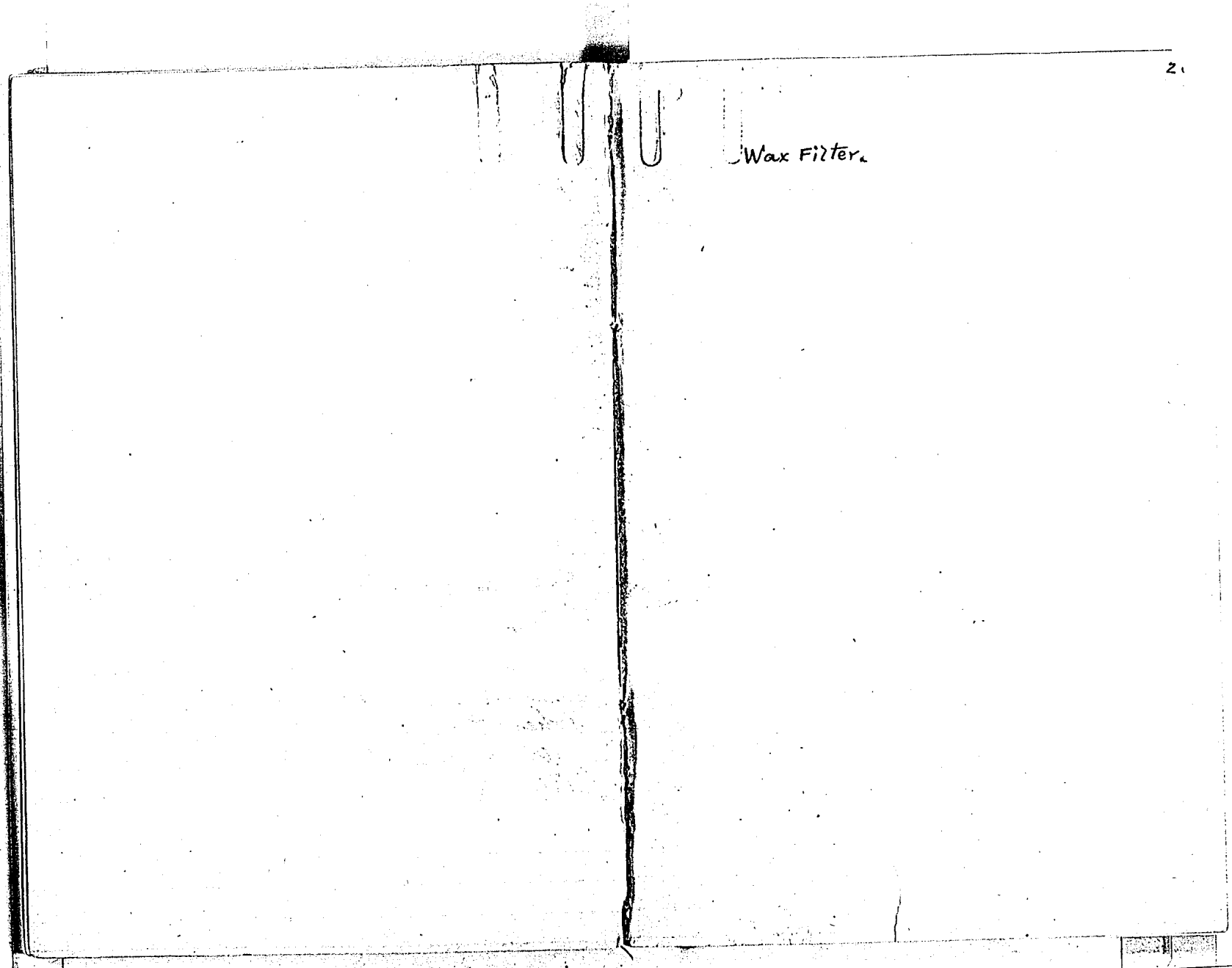
J 
wax cooled too fast on one side by water jacket. unless caused by cooling too fast on one side after removing from mould.

"Stearic Acid" is about ½ Palmitic Acid. It is double pressed hot to remove the Oleic acid which should not be much in excess of 3% - more oleic acid will cause wax to be attacked by air. and probably make it more easily attacked by plating solutions according to Mr. Bjerkworth.

Vaseline or Petrolatum which is crystaline and breaks short causes the wax to be attacked by the solution much more than the sticky oily kind.

Wax is attacked by solution less when Standard Oil Company FFF Valoe oil is substituted for vaseline than any other of about 80 softening media tried.

When wax is attacked by solution the mould looks red when stript from wax. When it is not attacked the copper is left covered with graphite and when cleaned leaves beautiful polished surface


Wax Filter

Graphite.

Dixon 097 Graphite 1 part. Caustic Soda 2 parts or more.
Heated red hot for two hours.
(Pored red hot into water)
Wash out Silicate of Soda. Can be washed out more thoroly by adding soda to 2 or 3 waters as silicate is unstable except in presence of Alkali.
After thoro (2 washes) washing boil in Hydrochloric Acid to remove iron. 24 hours —
After thoro (2 washes) washing and drying boil one hour in strong Nitric & Sulfuric Acid equal parts. to split flakes and increase conductivity.
About 6 parts acid to one part graphite required.
Dixon 0485 Graphite is about as good as 097.

T. P. Kelley Foundry Supply Co. 544 W 22d St, N.Y.
No 56 Smoke graphite 8¢ lbs has best conductivity is very fine but does not stick to celluloid as well as the Dixon 097 as treated by us.
When treated by above process it cakes.

Finger Marks.

on Wax master – Made before graphite – may show on stript wax.
After graphite – do not show on stript wax unless rubbed.

on submaster celluloid print. Made before final graphite – show black on copper mould when stript.
Made after final graphite – shows copper colored on copper mould. Very conspicuous is made with oily fingers. but always leave less graphite on mould than parts not touched.

[ITEM(S) FOUND IN BOOK]

Mr. Denniddie -

Following is a list of dates on which Cammol Hope has been added to the Cu. plating solution. The last date you have is Dec 24-13, 1250 C.C. in Lower Plating Room a Crock 3-4. Upper Plating Room will be known as Crock 1-2 The Iron Tables will be known as 5-6 and 7-8

Crocks 1 - 2	Crocks 3 - 4	Crocks 7 - 8
	1250 C.C. Dec. 29-13	
1250 C.C. Jan 2 - 14	1250 " " Jan 2 - 14	
	1250 " " " 8 - "	
1250 " " " 12 - "	1250 " " " 13 - "	
1250 " " 19 - "	900 " " " 19 - "	
	650 " " " 23 - "	5000 C.C Jan. 30 - 14
1250 " " " 24 - "		
	700 " " " 26 - "	
	800 " " " 29 - "	
1250 " " " 30 - "		
	800 " " Feb 2 - 14	
	800 " " " 5 - "	2500 C.C. Feb. 5 - 14
1250 " " Feb. 5 - 14		
	800 C.C. " 9 - "	
1250 " " " 13 - 14	800 " " " 12 - "	700 " " " 12 - "
650 " " " 14 - "		
	800 C.C. " 16 - "	
650 " " " 18 - "		700 " " " 18 - "
2-19-14		Emmes.

[ITEM(S) FOUND IN BOOK]

April I7th, I9I7.

Mr. John V. Miller
Edison Chemical Works,
Silver Lake.

Re - Raw Material for Disc Masters:-

Ist. Stearic Acid:-
Copy of letter to Purchasing Dept. June 20-I9I6 attached shows what we have done.
The practical test referred to was to make a small sample of Wax as follows:-

4.64 grammes Caustic Soda
I.80 " Aluminum
I0I.60 " Sal Soda
II5. CC Water

Boil until all aluminum is dissolved and dilute to 300 CC.
This is enough for 9 test batches of wax as follows:-
50.5 g. Stearic acid from each sample.
33 I/3 cc of above solution.
put solution into the melted stearic acid slowly temp. 330 F. raise temp to 420 F. until foaming stops ; add 3.788 grammes of FFF valve oil; raise temperature to 450 F for two or three minutes stirring thoroughly with thermometer. Mould into a $2\frac{1}{2}$" diameter disc.

In testing a new sample a check test should be made using some stearic acid which we are using now, or know about, so that we may not be thrown off by some variation in the other ingredients.

The discs are then cut flat on one edge and part of one face shaved to expose a cut surface. They are then placed in plating solution half emersed for 24 hours to see if the wax is attacked by the solution. I have usually drilled a hole in center of each and strung them on a wire to prevent their falling over in the solution.

Oleic Acid causes the wax to be attacked by air; Mr. Aylesworth considered 3% the danger line.

We have never had anything like 3% Oleic in the tripple pressed stearic acid, and have never had any trouble from it.

(2nd. FFF Valve Oil made by Standard Oil Company ; this is tested by casting small discs same as we test the stearic acid, but we start with hard wax and take 50 g. of hard wax (wax made without oil, but complete otherwise) and add $3\frac{3}{4}$ grammes of each sample of oil. The best is the one least attacked by the solution - but it has to stand a more important test and furnish a proper softener to give the wax the right cutting qualities. This can only be determined by making up Disc Masters and recording on them. A considerable difference might not be apparent until a change of season from Summer to Winter might make it impossible to use the wax.

(3rd. The Caustic Soda is the same as used by the Edison Primary Battery.

(4th. The Sal Soda must be recrystalized.
This is not a matter of purity, but the anhydrous will not combine with the aluminum.
If the weight is not all crystals, the proportions are not correct.

(5th. The aluminum we have been using is rolled sheet metal which we have not tested in any way but buy it for commercially pure aluminum.

If there is anything not quite clear in the preceeding, or if I can be of any further service in regard to this matter, please call on me.

W.W. DINWIDDIE.

noted & Copied 5-5-20 W.W.D.

[ITEM(S) FOUND IN BOOK]

February 26th.1918.

Mr. J. V. Miller

For

Mr. W.W. McWilliams
Phenol Resin & Wax Dept. Chemical Works Division,
Edison Storage Battery Co., Silver Lake.

The following data in regard to mechanical work on wax blanks was furnished me for you by Mr. Gepfert who was at one time foreman of the Shaving Department.

SPEED OF MACHINES FOR FINISHING WAX BLANKS.

STANDARD BLANKS

Reamer	140	per min.
Edging	3080	" "
Rough cut Arbor	2850	" "
" " Feed	325	" "
Shaving	1800	" "

COMMERCIAL BLANKS

Reamer	140	Per Min
Edging	3080	" "
Rough Cut Arbor	2364	" "
" " Feed	320	" "
Shaving	1800	" "

LENGTH OF BLANKS

Standard	4 1/2 In.
Commercial	6-1/8 In.
Master	4-11/16 In.

DISC BLANKS

3/4 x 10-1/2

MASTER BLANKS

Boring	1200	per Min.
" Feed	400	" "
Rough Cut Arbor	2850	" "
" " Feed	575	" "
Edging	1875	" "
Bevel	2035	" "
Shaving	1117	" "

DISC BLANKS

Roughing	344	" "
Finishing	330	" "

DIAMETER OF BLANKS

Standard	2.187 In.
Commercial	2.335 to 2.212
Master	2.225 x 2.235

HIGH AND LOW

Commercial	2-3/8 to 2-1/16
Standard	2-13/64 " 2-1/16

W.W. DINWIDDIE.

Copy to Mr. R. Lee.

[ITEM(S) FOUND IN BOOK]

Speeds of machines for forming wire blanks

Standard

Reamer	410	per Min
Edging	3080	" "
R Cut feed	325	" "
" " Arbor	2850	" "
Shaving	1800	" "

Comm. blanks

Reamer	410	" "
Edging	3080	" "
R Cut Arbor	2364	" "
" " feed	320	" "
Shaving	1800	" "

Master blanks

Boring Arbor	1200	" "
" Feed	400	" "
Rough Cut Arbor	285-0	
" " feed	575-	" "
Edging	1875-	" "
Beveling	2035-	" "
Shaving	1117	" "

Disc blanks

Roughing	344	" "
Shaving	330	" "

Lenght of blanks

Standard	4 1/4 in
Comm	6 1/8 "
Master	4 "/16 "

Diam of blanks

Standard	2.187 in
Comm	2.335- " to 2.212 in
Master	2.225- X 2.235-

Disc Master blanks
3/4 X 10 1/2

Hight & Low
Comm
2.375- to 2.0625-
Standard
2.202 to 2.0625-

[ITEM(S) FOUND IN BOOK]

Speed of machines for finishing wax blanks

Standard blanks

Reamer	140	per min
Edging	3080	" "
Rough cut arbor	2850	" "
" " feed	325	" "
Shaving	1800	" "

Comm blanks

Reamer	140	" "
Edging	3080	" "
Rough cut arbor	2364	" "
" " Feed	320	" "
Shaving	1800	" "

Waster blanks

Boring	1200	per min
" Feed	400	" "
Rough Cut Arbor	2850	" "
" " feed	575	" "
Edging	1875	" "
Bevel	2035	" "
Shaving	1117	" "

Disc Blanks

Roughing	344	" "
Finishing	330	" "

Lenghts of blanks.

Standard	4 1/4 in
Comm	6 1/8 "
Waster	4 11/16 "

Diam of blanks

Standard 2.187 in
Comm 2.335 to 2.212.
Waster 2.225 X 2.235

Disc Blanks
3/4 X 10 1/2

High & Low

Comm 2 3/8 to 2 1/16

Standard 2 13/64 to 2 1/16